May 24 to June 8, June 30 to July 12, July 18 to August 7, and December 22–31. And not only were there these long and numerous breaks in the spot manifestations, but when spots were seen they were almost always small in size and few in number. On not a single day in the year did the total spotted area amount to $\frac{1}{1200}$ of the surface of the visible hemisphere; on only eight days did it exceed $\frac{1}{2000}$. The mean daily spotted area for the year amounted only to about 9 parts in 100,000, or almost precisely the same as in 1877. In January there was a feeble but fairly sustained display of activity up to the 22nd; there was a similar but less lasting manifestation at the end of February, and again about the middle of March. April was very quiet, but May 11–23 yielded a fair show of spots, May 14 giving the largest area of the year. August 28 to September 9 was also a fairly active time; but the most prolific month as to entire spotted area, though not as to number of spots, was November, following immediately after the longest period of entire quiescence. The last ten days of last year, and the first two months of the present, have been exceedingly barren.

A rough tendency has manifested itself in the past as in previous years, for quiet intervals to follow each other at the distance of half a synodic rotation of the sun, indicating a preference of the spots for a few favoured longitudes. In latitude, the spots have continued to be more numerous in the southern hemisphere—a condition of things that has prevailed, on the whole, ever since the dying away of the great spot of November 1882. Generally speaking, the spots have lain close to the equator, not often rising above 5° or 6° of latitude in the northern hemisphere, and 9° or 10° in the southern; but the same curious pulsation shown in the great eleven-year cycle has been also visible in these minor oscillations, and whenever there has been anything like an outburst, there has also been an effort to ascend to higher latitudes. Thus, the greatest display in the northern hemisphere, that of November, lay in lat. + 11°; whilst a part of the outbreak in the southern hemisphere in September reached lat. – 16°.

The monthly numbers for spots and faculæ given by Prof. Tacchini, in the *Comptes rendus*, vol. cvi. No. 18, vol. cvii. No. 6, and vol. cviii. No. 7, are as follows, and may be compared with those given for previous years in NATURE, vol. xxxiii. p. 398, vol. xxxv. p. 445, and vol. xxxvii. p. 423:—

	Relative frequency of days without spots.	Sun-spots.			Faculæ.
		Relative frequency.	Relative size.	Mean daily number of groups.	Relative size.
January	0·21	2·70	11·17	1·30	14·13
February	0·74	2·30	5·91	0·48	11·09
March	0·61	1·70	6·22	0·48	14·57
April	0·39	1·65	4·31	0·89	13·65
May	0·54	2·50	18·77	0·46	7·20
June	0·42	3·71	4·18	0·79	17·52
July	0·68	1·10	3·45	0·42	15·81
August	0·46	1·86	13·71	0·68	14·29
September	0·04	4·80	40·12	1·68	27·80
October	0·80	0·68	1·12	0·08	5·72
November	0·41	3·12	21·88	0·77	9·12
December	0·44	2·44	10·64	0·56	10·22

The foregoing table shows that the faculæ have not by any means varied simultaneously with the spots, and that their diminution as compared with 1886 and 1887 has been but slight. They showed, however, a very noticeable development during the secondary maximum of September, whilst the prominences, on the other hand, fell off considerably both in September and November, but attained their greatest development during the year about March and April, when the spot activity was decidedly feeble. This diversity of behaviour shows that the connection between the spots and hydrogen prominences is less intimate than it has sometimes been stated to be. Nevertheless, the prominences also afford very distinct evidence of a continued decline, as the following figures, given by the Rev. S. J. Perry in the *Observatory* for March, will show:—

	Mean height of chromosphere.	Mean height of prominences.	Mean extent of prominence arc.
	″	″	° ′
1886	8·05	24·78	13 36
1887	8·13	23·86	9 29
1888	8·06	20·96	6 46

The highest individual prominences recorded by Prof. Tacchini were 2′ in height, and were seen on January 10 and February 7.

The magnetic variation has also shown a decline during the year in fairly faithful parallelism to the sun-spots; indeed, the accordance has, according to Dr. R. Wolf, been closer in 1888 than in 1887. The following are the numbers he gives in the *Comptes rendus*, vol. cviii. No. 2:—

1888.	Wolf's relative numbers (Zurich). *r*.	Δ*r*.	Variation in magnetic declination (Milan). *v*.	Δ*v*.
			′	′
January	13·0	– 0·1	3·03	– 0·68
February	7·0	– 8·7	3·02	– 0·67
March	6·3	+ 3·6	7·11	+ 0·12
April	3·9	– 3·6	8·27	– 1·06
May	7·8	– 9·4	8·48	– 0·82
June	6·5	– 9·8	9·27	– 0·28
July	1·9	– 24·3	8·58	– 1·67
August	1·9	– 19·2	9·17	+ 0·10
September	7·8	+ 0·9	7·31	+ 1·23
October	2·0	– 3·5	6·32	+ 0·29
November	12·9	+ 8·4	2·18	– 0·89
December	9·9	– 10·6	1·76	– 0·47
Mean	6·7	– 6·4	6·21	– 0·40

The formula $v = 5'{\cdot}62 + 0{\cdot}045r$, which Dr. Wolf has established for Milan, would give $v = 5'{\cdot}92$ if $r = 6{\cdot}7$, whilst the observed value of v was $6'{\cdot}21$, a difference of $0'{\cdot}29$. The difference between the observed and computed values was $0'{\cdot}40$ for 1887.

COMET 1889 *a*.—This object, discovered by Mr. Brooks on January 14, appears to be lost. Prof. Holden, writing on January 30 to the editor of the *Astronomische Nachrichten*, states that both Mr. Barnard and Prof. Swift had carefully searched for it with the Lick instruments, but without success.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 *MARCH* 10–16.

(**FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.**)

At Greenwich on March 10

Sun rises, 6h. 26m.; souths, 12h. 10m. 21·6s.; sets, 17h. 54m.: right asc. on meridian, 23h. 23·8m.; decl. 3° 54′ S. Sidereal Time at Sunset, 5h. 8m.

Moon (at First Quarter on March 9, 18h.) rises, 10h. 41m.; souths, 18h. 53m.; sets, 3h. 9m.*: right asc. on meridian, 6h. 7·2m.; decl. 21° 54′ N.

Planet.	**Rises.** h. m.	**Souths.** h. m.	**Sets.** h. m.	**Right asc. and declination on meridian.** h. m.	° ′
Mercury	5 39	10 28	15 17	21 40·7	14 15 S.
Venus	7 18	14 52	22 26	2 5·6	16 54 N.
Mars	7 12	13 46	20 20	0 59·9	6 4 N.
Jupiter	3 14	7 10	11 6	18 22·5	23 2 S.
Saturn	14 16	21 54	5 32*	9 9·2	17 38 N.
Uranus	20 43*	2 8	7 33	13 19·3	7 40 S.
Neptune	8 55	16 38	0 21*	3 51·8	18 30 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Mar.	h.	
13	11	Mercury at greatest elongation from the Sun, 28° west.
14	6	Saturn in conjunction with and 1° 0′ south of the Moon.

Variable Stars.

Star.	**R.A.** h. m.	**Decl.** ° ′		h. m.	
W Tauri	4 21·7	15 51 N.	Mar. 12,		*M*
R Canis Majoris	7 14·5	16 11 S.	,, 11,	19 57	*m*
		and at intervals of		27 16	
S Geminorum	7 36·4	23 43 N.	Mar. 14,		*M*
S Cancri	8 37·6	19 26 N.	,, 11,	18 38	*m*
T Cancri	8 50·3	20 16 N.	,, 14,		*M*
R Ursæ Majoris	10 36·8	69 22 N.	,, 15,		*m*
R Crateris	10 55·1	17 44 S.	,, 16,		*m*
U Coronæ	15 13·7	32 3 N.	,, 11,	0 32	*m*
S Serpentis	15 16·5	14 43 N.	,, 11,		*M*
T Vulpeculæ	20 46·8	27 50 N.	,, 10,	21 0	*m*
			,, 11,	23 0	*M*
Y Cygni	20 47·6	34 14 N.	,, 10,	5 40	*m*
			,, 13,	5 40	*m*
δ Cephei	22 25·0	57 51 N.	,, 10,	20 0	*m*

M signifies maximum; *m* minimum.

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Meteor-Showers.

	R.A.	Decl.	
Between Lynx and Auriga	98°	46° N.	
Near ν Virginis	175	10 N.	Slow ; bright.
,, κ Cephei	300	80 N.	Slow ; bright.

GEOGRAPHICAL NOTES.

M. ROLLAND, a French naturalist, charged with an official mission to Madagascar, has sent in his Report to the Minister of Public Instruction. M. Rolland sums up his geographical observations by remarking that, notwithstanding its apparently simple contour, the topography of Madagascar is exceedingly complex. Behind the line of lagoons which border the coast, and which, except that the water is salt, remind one of the *étangs* of Languedoc, the hills begin to rise, and increase in height towards the interior. Behind these, again, the mountains rise by stages to a height of over 6500 feet. The surface is cut up by innumerable ravines, at the bottom of which are torrents, which rush on their way towards the Indian Ocean. This chain forms the backbone of the island, and consists mainly of Primary and crystalline rocks. When it is crossed, the Mozambique Channel is reached. The two slopes, east and west, are very unequal in extent. The former, which M. Rolland has explored to a considerable extent, occupies more than one-third of the total area of Madagascar. A broad valley, that of the Mangoro, runs north and south, parallel to the great central chain and the coast. Unfortunately, the Mangoro is not navigable, even for canoes. The two other most important rivers are the Manangoro and the Mangataka ; and these three rivers, with innumerable streams, render this part of the island one of the best-watered regions on the globe. The climate varies considerably from one zone to another. On the east coast the temperature oscillates between 13° and 30° C. ; on the west coast, it never descends below 17° ; in Imerina province it ranges from 5° to 25°. M. Rolland refers in some detail to the well-known characteristics of the fauna of Madagascar, and to the abundance of mineral treasures, especially iron, copper, and lead ; but, he states, the natives carefully conceal the localities of the beds.

LIEUT. VANS AGNEW has undertaken a journey to the Upper Salween and South-Eastern Tibet, with the object of attempting the solution of the problem of the course of the Lu River—whether to the Irawadi or the Salween—propounded by General J. T. Walker in his paper read to the Royal Geographical Society on April 25, 1887. The Council of the Society have sanctioned a contribution of £100 towards the expenses of the expedition. Lieut Vans Agnew leaves India for the Salween in the course of the present month.

AT the February meeting of the Berlin Geographical Society Dr. A. Schenck read a report on his recent journey in Nama Land and Herero Land, South-West Africa. He showed that the whole country between Walfisch Bay and the Orange River is—in consequence of the purely mechanical decomposition of the prevailing granitic rock, which is taking place under the great daily variations of temperature, causing in many places the disintegrated surfaces to be eaten away in the form of a crust—covered over with a sea of sand and granitic shingle, from which the highest elevations stand out like islands. The country is not suited for agricultural colonies. The coast and the interior stand in contrast with regard to the season of rainfall. While on the coast the rain falls mostly in winter, the rainfall in the interior occurs only in summer, and nearly always in the form of thunder-showers, which, as Dr. Schenck believes, are caused by the condensation of the moisture-laden air, which is brought to this part by the warm, humid, north-east winds from the more equatorial regions of Africa, through coming into contact with the cool south-west winds blowing from the coast to the interior. As to the configuration of Great Nama Land, Dr. Schenck gives the following notes. After the hilly coast-region between Angra Pequena and Aos is passed, a broad valley-like depression is reached, filled up with drift-sand. East of the depression the country ascends and forms a stony, desolate plain, out of which rise isolated peaks or longer mountain-chains running in a north and south direction. The whole of this district, as far as Aos, forms a connected mountain system composed of ancient rocks, granite, and gneiss, which has been buried by the sand from which the higher parts stand out. Beyond Aos the traveller enters upon the steppe region, which is divided into detached plateau districts. Beyond Aos and the river-bed of the Goăgib, on which the station of Bethanien is situated, the Huib plateau stretches away to the north, as far as the region of Khuias, and to the south to a point a few miles north of the Orange. A long series of table-mountains, resembling in form truncated cones, mark the western escarpment of this plateau ; the former are composed of granite and gneiss, and are covered with limestone and sandstone, horizontally laid down. East of Bethanien, and corresponding with the line of a long geological fault, is the escarpment of another plateau ; it is about 5000 feet in height. It descends to the Great Fish River on the east ; on the other side of the river, the plateau character of the country is continued to the Karas Plateau, which extends into the brush steppe of the Kalahari. Further details concerning this interesting region will be found in the March number of the Proceedings of the Royal Geographical Society.

THE FORCES OF ELECTRIC OSCILLATIONS TREATED ACCORDING TO MAXWELL'S THEORY. BY DR. H. HERTZ.[1]

II.

Note by the Translator.

IT is to be noted that Hertz follows the French system of wave-lengths and periods. Had I noticed this before the diagrams went to the engraver, I would have altered it, and interpreted his T as ½T, &c., throughout. As it is, I have left them everywhere as in the original. My elaborate attempt to evade a literal translation of *Doppelpunkt* was quite unnecessary. Prof. Karl Pearson has sent me a reference to Maxwell's definition of "double-point" in vol. i. Art. 129, first edition of "Electricity and Magnetism."—O. J. L.

In order now to ascertain the distribution of force for the remaining parts of space we may use graphic representation, constructing for definite times the lines of electric force, viz. the curves Q = const., for equi-distant values of Q.

Since Q itself is the product of two factors, of which one depends only on r, the other only on θ, the construction of these curves presents no great difficulty.

We decompose every value of Q for which we want the curve into two factors in different ways ; we determine the angle θ for which $\sin^2 \theta$ is equal to the one factor, and by means of an auxiliary curve that value of ρ for which the function of ρ contained in Q is equal to the other factor ; we thus get as many points as we please of the curve. When one attempts to carry out the construction one perceives many small processes which it would be prolix to detail here. We will content ourselves with examining the results of such construction, as exhibited in Figs. 1, 2, 3, 4.

These figures represent the distribution of force at the times $t = 0, \frac{1}{4}T, \frac{1}{2}T, \frac{3}{4}T$; and also, by suitable inversion of the arrows, for all future times which are similar multiples of ¼T. At the origin is shown, in the correct aspect and about of the right proportional size, the arrangement by which in our earlier experiments the oscillations were excited.

The lines of force are not indicated right up to the picture because our formulæ regard the oscillators as infinitely short, so in the neighbourhood of a finite oscillator they are insufficient.

Let us begin a study of the figures with Fig. 1. Here, when $t = 0$ the radiation is in the condition of its strongest development, but the poles of the straight oscillator are not electrically charged—no lines of force start thence. Such lines of force begin, however, now from the time $t = 0$ to start out from the poles ; they are inclosed in a sphere which expresses the value Q = 0. In Fig. 1 this sphere is indeed still vanishingly small, but it enlarges itself quickly, and by the $t = \frac{1}{4}T$ it fills already the space R_1 (Fig. 2). The distribution of lines of force inside the sphere is approximately of the same kind as correspond to a static electric charge on the pole. The speed with which the spherical surface Q = 0 spreads out from the origin is at first much greater than $\frac{1}{A}$ [or "v"] ; in fact, the latter velocity would only correspond to

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[1] Translated and communicated by Dr. Oliver Lodge. Continued from p. 404.

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